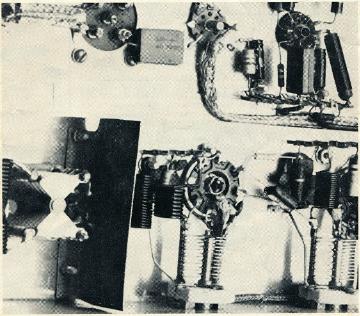
AMATEUR RADIO

FEBRUARY 1964



Vol. 32, No. 2

2/-

Registered at G.P.O., Melbourne, for transmission by post as a periodical

NEW VALVES AT BARGAIN PRICES

1A3 2/6 10 a £1
1A5 5/- 5 a £1
1C7 3/- 7 a £1
1D8 7/6 3 a £1
1F5 10/-
1H5 7/6
1H6 5/- 5 a £1
1K4 5/- 5 a £1
1K5 5/- 5 a £1
1K7 5/- 5 a £1
1L4 5/-
1LN5 (CV781) 5/- 5 a £1
1M5 5/-
1P5 2/- 10 a £1
1Q5 5/- 5 a £1
1S2 18/-
1S5 10/-
1T4 10/-
2A5 7/6
2A6 7/6
2D21 12/-
2X2 5/- 5 a £1
3A5 10/-
3S4 10/-

5U4GB 14/6
5V4G 17/6
5Y3GT 13/9
6A6 7/6
6AB7 10/-
6AC7 5/- 5 a £1
6AG5 5/- 5 a £1
6AG7 12/6
6AJ5 7/6 3 a £1
6AK5 20/-
6AL5 14/-
6AM6 (EF91) 10/-
6B6 7/6
6B8 metal 17/6
6BE6 15/-
6BQ5 17/-
6C4 5/- 5 a £1
6C6 5/-
6C8 10/-
6CM5 25/-
6F5 7/6
6F6 12/6
6F8 5/-
6G6G 7/6
6G8G 26/-

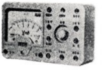
6H6GT 3/6
6J5GT 10/-
6K7 5/- 5 a £1
6K8GT 12/6
6L7 5/- 5 a £1
6R7 7/6
6SC7 7/6
6SF5 7/6 3 a £1
6SF7 7/6
6SH7 4/- 5 a £1
6SJ7 12/6
6SK7GT 20/-
6SL7WGT 12/6
6SN7 12/6
6SQ7GT 22/-
6SS7 7/6 3 a £1
6U8 17/-
6V4 11/4
6V6GT 16/-
6X4 10/-
6X5 15/-
6Y6 5/- 5 a £1
7A8 2/- 11 a £1
7C5 5/- 5 a £1
7C7 5/-

7E6 3/6 7 a £1
7W7 2/6 10 a £1
12A6 4/- 6 a £1
12AH7 5/- 5 a £1
12AT7 15/-
12AU7 15/-
12C8 5/-
12H6 3/6
12J5 5/- 5 a £1
12SA7GT 10/-
12SC7 5/- 5 a £1
12SK7 5/- 5 a £1
12SQ7 5/-
12SR7 5/- 5 a £1
14A7 3/6 7 a £1
19 1/6
30 1/3
47 3/6 7 a £1
57 4/-
58 3/-
717A 7/6 3 a £1
725A 20/-
808 10/-
809 20/-

815 15/-
830B 15/-
832A 19/6
866 32/6
884 10/-
954 5/- 5 a £1
955 5/- 5 a £1
956 5/- 5 a £1
958A 2/6 10 a £1
1616 20/-
1625 5/- 5 a £1
1626 5/- 5 a £1
1629 5/- 5 a £1
2051 5/-
4/250 £6/10/0
Socket to suit £1
5763 28/-
9002 10/-
9004 5/- 5 a £1
AV11 2/11
EA50 2/- 10 a £1
EC91/6AQ4 10/-
ECC35 20/-
ECH33 20/-
ECH35 7/6

EF36 5/- 5 a £1
EF39 5/- 5 a £1
EF50 (VR91) and socket 3/6
EF70 5/- 5 a £1
EF72 5/- 5 a £1
EF73 5/- 5 a £1
EF86 26/-
EL41 10/-
EY91 5/-
KT61 (6V6) 15/-
QQE04/20 £3½
QQV06/40 97/6
RL18 7/6 3 a £1
UL41 7/6 3 a £1
VR53 5/- 5 a £1
VR100 (6U7) 7/6
VR102 5/- 5 a £1
VR103 5/- 5 a £1
VR136 2/- 12 a £1
VR137 2/6
VT25 5/-
VT78 (6D6) 5/-
VT127 4/11 5 a £1
VT501 7/6 3 a £1

TECH MULTIMETER



300 μA. movement.

AC and DC voltages: 0-10, 0-50, 0-250, 0-500, 0-1000v.

Current ranges (mA.) 0-1, 0-100, 0-500 mA.

Ohms range: 0-100,000 ohms.

Size: 3¾ x 2½ x 1¼ inches.

Complete with leads.

Price only 57/6, post paid.

POWER CHOKES

12 Henrys, 125 mA., 275 Ohms, **£2/8/0**
12 Henrys, 100 mA., 290 Ohms, **£1/12/0**

ENGLISH INDICATOR UNITS TYPE 1

Contains: one 6" c.r. tube VCRX263, three CV327/EF52, five CV858/ECC91/6J6, two CV140/EB91/6AL5, and one 6V6GT. Brand new condition. **£6/10/0.**
5/- delivery charge to railhead.

SAKURA CIRCUIT TESTER
Model TR65

Sensitivity: d.c. 20,000 ohms/volt, a.c. 10,000 ohms/volt. Ranges, d.c. volts: 6, 30, 120, 600, 1,200; a.c. volts: 6, 30, 120, 600, 1,200. D.c. current, 60 μA., 6 mA., 60 mA., 600 mA. Resistance: 10K, 100K, 1M, 10M ohms. Capacitance 0.001-0.2 μF., 0.0001-0.01 μF. Inductance: 30-3,000H. Decibels: minus 20 to plus 17 db. (0 db.—0.775v.—600 ohms). Dimensions: 4⅛ x 6¼ x 2⅜ in. Weight 1.3 lbs.

Price £9/10/- inc. tax

CERAMIC CONDENSERS

Pigtail type. Sizes available: 1, 1.5, 2.2, 3.3, 4.7, 5.6, 6.8, 8.2, 10, 12, 15, 18, 22, 27, 29, 33, 39, 56, 68, 82, 100, 120, 150, 220, 270, 330, and 390 pF. **1/- each**, or **24 for £1.**

MULTIMETER Model 200H

20,000 ohms per v. d.c. 10,000 ohms per v. a.c.

Specifications:
D.c. volts: 0-5, 25, 50, 250, 500, 2,500.
A.c. volts: 0-10, 50, 100, 500, 1,000.
D.c. current: 0-50 μA.; 25, 250 mA.
Resistance: 0-60K ohms; 0-6 meg.
Capacity: 0.01-0.3 μF. (at a.c. 5v.); 0.0001 - 0.01 μF. (at a.c. 250v.).
Decibel: minus 20 db. plus 22 db.
Output range 0-10, 50, 100, 500, and 1,000.
Battery used: UM3 1.5v. 1 piece.
Dimensions: 3¼ x 4½ x 1-1/8 in.

Complete with internal battery, testing leads and prods.

Price £5/12/6 inc. tax.

AMERICAN POTENTIOMETERS

American Bradley, 2" long, ¼" shaft, 1" diam. Available in following sizes: 10,000, 20,000, 25,000, 30,000, 50,000, 100,000 ohms. **Price 2/6 each.**

CRYSTAL MICROPHONES

Price only 52/6

Stand to suit 15/- extra.

Model BM3 (illustrated): Response 100-8,000 c's., fitted with 6 ft. cable and phone plug with on-off switch. Can be used on stand for hand use.

BM3 Insert .... **10/- each**

CO-AXIAL CABLE

50 ohm, UR67, 3/8" diam., in 25 yd. Rolls **30/-**; or 1/6 yard.
71 ohm UR32, 3/16" diam., in 100 yard Rolls **£7/10/0.**
72 ohm UR70, 3/16" diam., in 27 yd. Rolls **30/-**; or 1/6 yard.
72 ohm, 3/8" **2/- yd.**, £8/15/0 100 yds.
100 ohm, 3/8" **2/- yd.**, £8/15/0 100 yds.

LSG11 SIGNAL GENERATOR

120 Kc.-390 Mc.

Freq. range (six bands): 120 Kc. to 130 Mc. on fundamentals; 120 to 390 Mc. on harmonics. Mod. freq. 400 and 1,000 c.p.s. Tubes: 12BH7, 6AR5. Rectifier: half wave selenium. Provision for crystal oscillator (xtal not supplied), 1 to 15 Mc. 100, 117 or 230v. a.c. input, 50/60 c.p.s. Size: 7½ x 10¾ x 4½ in. Weight: 6 lb.

Price: LSG11, £16/10/6 inc. tax.

HAM RADIO SUPPLIERS

5A MELVILLE STREET, HAWTHORN, VICTORIA Phone 86-6465

North Balwyn tram passes corner. Money Orders and Postal Notes payable North Hawthorn P.O. 5/- Packing Charge.

We sell and recommend Leader Test Equipment, Pioneer Stereo Equipment and Speakers, Hitachi Radio Valves and Transistor Radios, Kew Brand Meters, A. & R. Transformers and Transistor Power Supplies, Ducon Condensers, Welwyn Resistors, etc.

"AMATEUR RADIO"

JOURNAL OF THE WIRELESS INSTITUTE OF AUSTRALIA. FOUNDED 1910.

FEBRUARY 1964

Vol. 32, No. 2

Editor:
K. M. COCKING VK3ZFQ

Publications Committee:
G. W. Baty (Secretary) VK3AOM
A. W. Chandler (Circulation) VK3LC
S. T. Clark VK3ASC
R. S. Fisher VK3OM
R. W. Higginbotham VK3RN
E. C. Manifold VK3EM
K. E. Pincott VK3AFJ

Advertising Enquiries:
C/o. P.O. Box 36, East Melbourne, C.2, Vic.
OR
Mrs. BELLAIRS, Phone 41-3535. 478 Victoria Parade, East Melbourne, C.2, Victoria. Hours 10 a.m. to 3 p.m. only.

Publishers:
VICTORIAN DIVISION W.I.A.,
Reg. Office: 65a Franklin St., Melbourne, Vic.

Printers:
"RICHMOND CHRONICLE," Phone 42-2419. Shakespeare Street, Richmond, E.1, Vic.

★

All matters pertaining to "A.R.," other than subscriptions, should be addressed to:

THE EDITOR,
"AMATEUR RADIO,"
P.O. BOX 36,
EAST MELBOURNE, C.2, VIC.

Acknowledgments will be sent following the Committee meeting on the second Monday of each month. All Sub-Editors should forward their articles to reach "A.R." before the 8th of each month. Any item received after the Committee meeting will be held over until the next month. Publication of any item is dependent upon space availability, but in general about two months may elapse before a technical article is published after consideration by the Publications Committee.

★

Members of the W.I.A. should refer all enquiries regarding delivery of "A.R." direct to their Divisional Secretary and not to "A.R." direct. Non members of the W.I.A. should write to the Victorian Division, C/o P.O. Box 36, East Melbourne. Two months' notice is required before a change of mailing address can be effected. Readers should note that any change in the address of their transmitting station must, by P.M.G. regulation, be notified to the P.M.G. in the State of residence, in addition "A.R." should also be notified. A convenient form is provided in the "Call Book".

★

Direct subscription rate is 24/- a year, post paid, in advance. Issued monthly on the first of the month, January edition excepted.

★

OUR COVER

An unfinished project for a v.h.f. transmitter forms the cover photo. Details will be given in a later issue of "A.R.," together with full constructional data.

FEDERAL COMMENT

★

Is the Future of the Amateur Service in the Balance?

This is a question which every Amateur in the world might well ask himself or herself and one which vitally concerns the Societies representing the Amateur Service in the various countries where Amateur transmitting is permitted.

Those who have taken the interest in Australia to read the facts relating to International Conferences cannot help but wonder how long the Amateur Service can hold out against the ever-increasing pressure for frequency space by the rapidly expanding commercial services.

If you are concerned about the future of your hobby you are commended to read the article "Two Plus Two Equals Four" by A. Prose Walker, W0DCA, W4CXA, in the October 1963 issue of the American Amateur publication "QST".

As well as giving an enlightened and experienced background of the modus operandi of International Conferences, Mr. Walker points up the great and urgent necessity for a world-wide Amateur programme of "defence" as a barrier against the future loss of Amateur frequency assignments. His summary in three major points is worthy of reprinting in this magazine . . .

(1) **"We must upgrade the Amateur Service to keep pace with the state of the art and through this acquired status gain increased prestige and respect from people and governments who exert vast influence on communications.**

(2) **"We must prepare for conference participation on both the national and international levels.**

(3) **"We must establish liaison throughout the world to the end that we all work together in presenting a united front to our respective governments, and through them, to the I.T.U."**

The Wireless Institute of Australia, representing the Amateur Service in this country, has been working along the line of these three major points for the past five years or more with greater vigor than hitherto was possible.

Our policy is now being planned a long way ahead and the road will not be an easy one. Whether you hold an A.O.C.P. or an L.A.O.C.P., your cherished hobby hangs in the balance because the pressure for frequencies now extends from the b.c. bands into the gigacycle region. If countries like America, where Amateur Radio holds the highest population density, are concerned with future prospects, then the problem is multi-fold in Region III. where the density is far less and widely dispersed. We might add another important point to Mr. Walker's summary . . .

(4) We must use every resource at our command to encourage the full and continual use of every frequency assigned to the Amateur Service.

FEDERAL EXECUTIVE, W.I.A.

CONTENTS

INTRODUCTION TO CERAMIC DIELECTRICS*

PART ONE

H. F. RUCKERT,† VK2AOU

AN ever-increasing variety of ceramic parts is being used in electronic equipment, and the ceramic dielectrics are one particular type of electronic ceramic. Before discussing the capacitor dielectrics in detail, it may be of interest to mention at least other electronic ceramics.

ELECTRONIC CERAMICS

(a) Low-loss steatite in 1932/34 replaced the electrical porcelain used as insulator material, in order to reduce electrical losses at radio frequencies. Dense aluminium oxide parts are also now being used for important applications in v.h.f. valves as vacuum-tight, low-expansion insulators.

(b) Ferrites, which contain mainly iron oxide plus zinc, manganese, nickel, etc., are now very widely used as core material in coils and transformers of b.c. receivers, tape recorders and t.v. sets, or as permanent magnets in loud speakers, t.v. sets, etc.

(c) Other ceramic bodies become semiconductive due to their composition and/or firing atmosphere and form voltage and temperature sensitive resistors, which are called thermistors, varistors, barrier layer capacitors, etc.

(d) Piezoelectric ceramics may soon replace many fixed tuned circuits in electronic apparatus, doing the combined job of a pair of coils and capacitors; also, they are superior to the seignette salt crystal so often employed in gramophone crystal pick-ups, microphones, and piezo ceramics are now being tried in motor ignition systems, etc.

(e) Special porcelains have long been used as the element carrier of carbon and wire-wound resistors.

(f) Glazes, ceramic flux or enamels found important applications in connection with the surface protection of ceramic insulators, transmitter capacitors and wire-wound resistors, as well as flux to bond painted-on silver, palladium, etc., electrodes to the ceramic base.

DEFINITIONS AND PROPERTIES

WHAT IS A DIELECTRIC AND A CAPACITOR?

The capacitor or electrical condenser was first reported to be used by Gray in 1735, by von Kleist in 1745, and by Cunaeus in Leyden (Leyden Flask) in 1746.

Gray used a glass bottle filled with water to collect electrostatic charges. Von Kleist found that the condensation of many small sparks, by charging the water in the bottle, was much improved by holding the bottle with one hand, because the discharging spark was now much stronger. In these cases, the water acted as one electrode, the glass as the insulating dielectric and the table or hand as the other electrode.

Cunaeus used metal foil as inner and outer electrodes, a technique still applied today, and we, therefore, call the "Leyden Flask" the original capacitor. We define a capacitor or electrical condenser as an electrical component consisting of two opposite placed electric conductors with an insulating medium "the dielectric" (vacuum, gas, liquid or solid) between these conducting electrodes.

What can we do with an electrical capacitor?

CHARGING, STORING, DISCHARGING, BLOCKING AND BY-PASSING

Charging: By connecting the electrodes to a battery or electric power supply, we notice that an electric current is rushing into the capacitor, which soon stops because the dielectric insulates both electrodes from each other.

Storing: Is the dielectric a good insulator, have steps been undertaken so that air humidity does not cause a conducting path to form, and is the insulation margin clean (no finger prints)? If so, then the charge can be stored in the capacitor for quite some time after it has been disconnected from the battery.

Discharging: The capacitor can be discharged by connecting a wire across the electrodes causing a short circuit, indicated by a spark.

Blocking: These experiments show us that d.c. is charging the capacitor but, after that, a further current flow is blocked by the dielectric.

By-passing: Applying a.c. to the capacitor means that we charge, discharge, re-charge with opposite polarity and discharge the capacitor again in quarter sine wave cycle steps repeatedly or continuously. That happens if the capacitor is connected to a power point. If we connect an a.c. current meter in series with the capacitor and the a.c. source, we will obtain a reading, which means that the effect of charging and discharging (a.c.) is transferred by the insulating dielectric to the other side without actually conducting the current.

This means that a capacitor can be used to separate d.c. from a.c. by blocking d.c. current and by-passing a.c. The by-passing effect is expressed as a.c. resistance of the capacitor called "**capacitive** reactance" (X_c).

UNIT OF CAPACITY

To express the storing capability of capacitors, we use the basic unit of **Farad** (Faraday).

1 F. holds the electric charge of 1 Coulomb (quantity) with 1 V.

1 Coulomb = 1 Amp. in 1 Sec. charging current.

In practice, we use smaller units:—

$$\frac{1}{1{,}000{,}000}\text{ F.} = 1\ \mu\text{F., or}$$

$$\frac{1}{1{,}000{,}000}\ \mu\text{F.} = 1\text{ pF.}$$

There are many types of capacitor meters now available to assist us if we wish to measure a capacitor.

Let us now look at the main properties.

K FACTOR

If we replace vacuum dielectric or dry air, which are nearly the same in this regard, by other insulating materials, we will usually observe a bigger charging and discharging spark, which indicates a higher capacity value. The degree of capacity so increased or multiplied is called "K Factor", permittivity or dielectric constant, and it is a ratio figure only without dimensions. The relationship between the capacitor dimensions, K factor and capacity is expressed as follows:—

$$K = \frac{\text{CpF.} \times \text{thickness}}{\text{eff. area} \times 0.224}$$

where thickness is 0.001".
area is in square inches.

Ceramic materials cover the widest range of F factors of all substances: 4 to 15,000.

Mica K, 7-8; glass, up to 18; plastics, 2 to 4; porcelain, 4.5; steatite, 6 to 7; distilled water, 81.

We divide ceramic dielectrics into two main groups, LK and HK, or K < 1,000 and K > 1,000 group.

The K factor varies with frequency, voltage, temperature, time and shape of the dielectric, the composition and manufacturing processes.

TEMPERATURE CO-EFFICIENT OF CAPACITY, TC_c

LK: Since the K factor is by no means constant, we don't use the old term "dielectric constant" any more. The change of K factor or capacity with temperature is called the TC_c or temperature co-efficient of the capacity. Negative, zero or positive TC_c values can only be achieved with ceramic dielectrics, which is the reason they are so important.

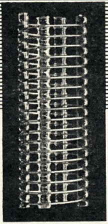
Radio Example: All radio or t.v. receivers, and many other electronic apparatus, have tuned circuits, each consisting of an inductor (in form of a coil) and a capacitor to sort out the desired radio station (frequency) from the many signals arriving at our aerial. Temperature variations, during the warming up period or later, cause a change of electrical properties of components which affects the radio receiver tuning, and frequency drift, loss of gain and selectivity are the results.

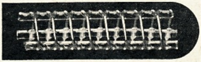
These effects can be automatically eliminated by incorporating ceramic capacitors with the required TC_c, or a combination of LK capacitors can be used, which compensates the TC of other components to a high degree.

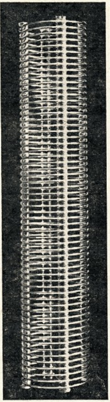
The TC_c is determined by measuring the capacity variation ΔC per degree C. of temperature change Δt:—

* From a Lecture given to the Ceramic Society of Australia (N.S.W. Division).

† 25 Berrille Road, Beverly Hills, N.S.W.







ILLUMITRONIC ENGINEER. CORP.
California, U.S.A.

air dux

air-wound inductors

Illumitronic Engineering has developed a complete versatile series of air core inductors designed especially for the Amateur rig, for prototypes and production models of r.f. transmission equipment. These coils may be used for pi output circuits, conventional LC output circuits, interstage and oscillator circuits. The series consists of a standard coil type, a variable pitch type, an indented type and special wound type, in a range of diameters from ½ inch to 5 inches. All Air Dux Coils are constructed of tinned or silver plated copper wire wound on large low-loss plastic rods for the highest mechanical strength and lowest electrical losses. Coils that resist heat distortion of temperatures up to 400°F. are available on special order for industrial and military use.

WRITE FOR FREE EIGHT-PAGE AIR DUX CATALOGUE

Australian Representatives:—

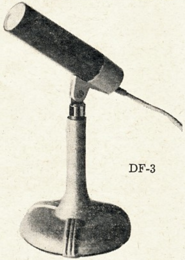
TRANSTRONIC PRODUCTS
123 BALGOWLAH ROAD, FAIRLIGHT, N.S.W.
Phone: 94-6181

A complete range of these Coils are also available from:—

Victoria:
J. M. MAGRATH & CO. P/L.
208 Lt. Lonsdale St., Melbourne
Phone: 32-3731

Queensland:
C. A. PEARCE PTY. LTD.
33 Bowen Street, Brisbane
Phone: 2-8510

FOSTER DYNAMIC MICROPHONES



DF-3

SPECIFICATIONS:

Output Impedance	50 ohms or 50K ohms
Effective output level	—55 db. [0 db. = (one) 1V. Microbar]
Frequency response	50 to 15,000 c.p.s.

OMNI-DIRECTIONAL DYNAMIC:

Plastic Diaphragm.
Size: 4½" long, 1¼" diameter.
Cable: 12 ft. of P.V.C.
Swivel fits 5/8" 26 t.p.i. Stands.
Colour: TWO-TONE GREY.

Retail Price 50 ohms: £4/7/9 + Sales Tax 10/11
Retail Price 50K ohms: £4/10/0 + Sales Tax 11/3

A QUALITY PRODUCT FOR TAPE RECORDERS & P.A. USERS

Marketed by **ZEPHYR PRODUCTS PTY. LTD.**
58 HIGH STREET, GLEN IRIS, S.E.6, VICTORIA   Phones: 25-1300, 25-4556

ZEPHYR

Manufacturers of Radio and Electrical Equipment and Components

Agents: D. K. Northover & Co.; Neil Muller Ltd.; Homecrafts (Tas.) P/L.; Jacoby, Mitchell & Co. P/L.; T. H. Martin P/L.

$$\frac{\Delta C \times 10^6}{C_0 \times \Delta t} = TC_C \text{ p.p.m.} \begin{Bmatrix}\text{parts per}\\ \text{million}\end{Bmatrix}$$

C_0 is initial capacity.

LK materials are being made with TC_C values from P150 to N5600, measured at 1 Mc. between 25 and 85°C.

All bodies have a certain low frequency and high temperature where the TC_C goes through zero (N.P.O.) and where the TC_C curve is no longer nearly linear.

HK: HK ceramics give usually high enough capacities for coupling and by-pass applications, and there is no need to use them in tuned circuits, so that their peculiar TC_C is of little importance. They have one or two K peaks between 0 and 150°C., which means that the TC_C curve shows several P, N.P.O. and N. regions.

The K peak is called Curie Point, because a change in the crystal structure of the used Ba TiO_3 from tetragonal to cubic and variations in electrical properties takes place at this temperature, where the K factor max. is observed. (Mme. Curie found similar effects on other substances.)

It is usually the aim to produce HK dielectrics which exhibit a low enough TC_C and max. K at the most likely encountered operating temperature range. Many thousands of titanate and oxide mixtures have been tested and scores of patents have been claimed since 1942 to find the best compromise between K, TC_C and other properties.

POWER FACTOR

LK: We have seen that different dielectrics result in different capacities, and it was mentioned that the K factor is affected by many other effects and operating conditions. It is, therefore, not surprising that the fast-charging and discharging cycle does not happen without loss of electric energy, when a.c. is applied, with the associated energy transfer via the electric field in the dielectric. In the extreme case, as in high-power radio transmitters, the dielectric is warming up or may even become hot.

The percentage of lost r.f. energy is expressed as %P.F. (P.F. = 1 ÷ Q, where Q is the Quality Factor). Electrical energy becomes heat due to dielectric losses, which depend on the ceramic, the operating temperature and frequency, the r.f. power load, the electric and heat conductivity of the electrodes and terminals, the ambient temperature, duration of operation, and the TC of the P.F.

In receivers, the P.F. affects the gain and selectivity and, in this way, we can measure the P.F. as $\Delta f/fr$ (tuned circuit bandwidth divided by resonance frequency).

Low capacity values, as those obtained with LK ceramics, are required in tuned circuits and, therefore, LK dielectrics should have an extremely low P.F. of 0.01 to 0.05% at 1 Mc. The TC of the P.F. should be low also, to make the LK bodies suitable for transmitter capacitors, where an r.f. load of 60 kva. at 3 Mc. may be acceptable for a well-assembled 3" diameter plate capacitor of 650 pF. The 25°C. P.F. should not double below 120°C. Even porous ceramics can have a low P.F. if we can keep the air humidity out and do not apply high voltage. There may be an application for these too.

HK: HK ceramic capacitors are usually only required in electronic equipment where the P.F. of 0.5 to 2.5% has no detrimental effects, as in by-passing and coupling applications. It is interesting to note that the TC of the HK P.F. is negative up to the usual operating temperature, but, at 150 to 250°C., we observe the usual increase so well known from other dielectrics. Most ceramics have a decreased P.F. at higher frequencies, but HK bodies make an exception sometimes.

INSULATION RESISTANCE

The dielectric has the purpose of assisting the storing of the electric charge and, therefore, it is important to have an I.R. as high as possible to reduce the leakage current through the dielectric. Ceramics are now being made with an I.R. of 10^{15} ohms per cm., but we usually accept 10^{10} ohms as satisfactory.

It is a big problem to find coating materials to protect the surface which are usable from a practical viewpoint, to retain the good I.R. under practical operating conditions.

Only at operating temperatures in excess of 200°C. does the I.R. become critical again. This is different, of course, in the case of extremely thin oxide films used as dielectric skin on semiconducting ceramics. The I.R. increases due to polarisation as the measuring time is increased. If temperature variations cause stress in HK samples, the piezoelectric effect can make a reliable I.R. measurement impossible.

AGEING AND RECOVERY

After firing or any heating cycle, the crystal structure has the tendency to relax and reduce internal stress. It is not surprising that, during this period also, the electrical properties change. This so-called ageing process is particularly evident in the case of HK ceramics and the degree of ageing is usually greater as the K factor increases. The I.R. increases whilst the K factor and P.F. decreases. The ageing seems to go on faster if the ceramic HK capacitors are kept at low temperatures, and stops at the Curie Point temperature. At higher temperatures, we observe a more or less pronounced recovery of the capacity. In most practical cases, TC_C, ageing and recovery are superimposed effects and we can only measure the ageing alone if we keep the capacitors at a constant temperature all the time.

The ageing rate is usually constant per time decade, e.g. 3% each during the first, the next 10, the next 100 and 1,000 days, which would amount to 12% K loss in three years. However, ageing is not a material constant either because a 0.008" thick K : 9000 sample may age three times faster than a 0.035" thick sample. The higher we heat the capacitor above the Curie Point (50, 150, 800°C.), the more complete is the capacitor's recovery, but the new ageing cycle commences immediately during the cooling down time.

POLARISATION

The application of a high d.c. voltage to the electrodes of HK capacitors causes various properties to change. The I.R. measured after 1 minute may rise to three times this value after 2 minutes and may, again, double in 10 minutes. Electrolytic capacitors, which rely on polarisation, behave in a similar manner.

With a low voltage (a.c. measuring voltage plus polarisation voltage) of about 2 V. per 0.001" dielectric thickness, we usually measure maximum capacity, but the application of a higher field strength causes, at first, a steep and, finally, a less severe capacity loss. This loss of K becomes most effective at Curie Point temperatures and tends to reduce the TC_C. A permanent K loss of 10 to 40% occurs if the polarising field strength becomes too high.

300v. on K : 9000 0.010" (breakdown at 1500v.)
700v. on K : 2500 0.010" (breakdown at 3000v.)
50v. on K : 4000 0.0005" (breakdown at 500v.)

By heating up to 100°C., we nearly restore the original capacity value. Strange properties will be found if a high operating temperature and a high field strength are used together. The a.c. measuring voltage has a substantial effect, also. 2v. r.m.s. per 0.001" dielectric thickness often gives maximum capacity, whilst 0.1v. may result in only half the capacity being measured. Reversing the polarity after an I.R. measurement causes at least initially a much lower I.R. when measured again. The working voltage limit of oxide skin dielectric (0.0001" to 0.002" skin thickness) is determined more by the capacity loss, with voltage applied, than by the danger of breakdown.

IONISATION, BREAKDOWN, NOISE

Ceramic dielectric bodies are an irregular mixture of crystals. None of the many production processes or commercial grades of raw materials will give a structure which is void free. When the body vitrifies, some voids will remain which trap furnace gases. In the case of the capacitor, these voids will be subjected to high field strengths, especially if the K factor is high, and ionisation, as in a neon light, can take place. We are usually able to observe that the P.F. is gradually increasing with several h.t. flash tests, especially if we reach 100 to 200v. per thousandth thickness. Eventually, the dielectric will break down and become punctured.

Before this happens, we can make the ionisation audible with the help of a suitable apparatus. If we apply r.f., we may need only 1v./thou. to obtain noise, also called scintillation. These faulty or overstressed dielectrics can cause noise in receivers and instability of oscillators. Generally speaking, dielectrics can withstand quite high voltages:

0.006" N.P.O. .... 7-8 kv. d.c.
HK oxide skin 0.0005" 500-800v. d.c.

The ceramic processes play, also, a vital part. The working voltage has to be kept below the ionisation level.

(Continued on Page 20)

ADCOLA
(Regd. Trade Mark)

SOLDERING TOOLS

are STANDARD EQUIPMENT in

ALL AUSTRALIAN ARMED SERVICES

and many other Government and Industrial Organisations using the finest in radio & electronic apparatus.

You can own, and your work will benefit by using, the

VERY BEST IN SOLDERING TOOLS

Illustrated: L64 3/16" Bit Model in L700 Protective Shield fitted with Accessories.

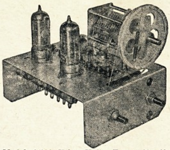
Further information from Manufacturers:—

ADCOLA PRODUCTS
PTY. LTD.

673 WHITEHORSE ROAD, MONT ALBERT, VIC.

Telephone 88-4351. **And all principle radio parts supply houses.**

GELOSO V.F.O.



Model 4/104 V.f.o. Unit. Tunes 80, 40, 20, 15, 11, and 10 Metres. Uses 6CL6 and 5763 valves. Supplied complete with handsome calibrated dial, pointer and perspex escutcheon. (Valves extra.) Notes on circuit, application and operation upon request.

Price: £10/5/- plus 12½% S.T.

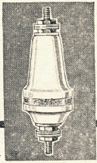
WILLIAM WILLIS & CO.
PTY. LTD.
428 ELIZABETH ST., MELB'NE
Phone: 34-6539

SUBSCRIPTIONS DUE

All members of the W.I.A. are reminded that annual subscriptions are now due and should be paid promptly to their Divisional Secretary. Non financial members will not receive a copy of "A.R.," and back copies may not be available upon request. To preserve continuity of your files of "A.R.," please pay your annual subscription now.

*AEGIS CERAMIC INSULATORS

We've* a wide range of small ceramic insulators for the equipment constructor! These are manufactured for lasting quality . . . send now for your copy of our* illustrated leaflet.



*AEGIS
COMMUNICATIONS

Aegis Manufacturing Co. P./L.
347 Darebin Rd., Thornbury, Victoria. 'Phone 49-1017.

A23.

S.S.B. CRYSTALS

Set of Five Gold-Plated Matched Crystals

Mounted in HC6U Holders
Suitable for 455 Kc. I.F's.

Price £16-10-0 per Set + 12½% Sales Tax

Full details on request.

BRIGHT STAR RADIO
46 Eastgate St., Oakleigh, S.E.12, Vic. Phone 57-6387

A STABLE TRANSISTORISED V.F.O.*

COMMANDER PAUL H. LEE, W3JHR

ALMOST everybody reads the "Bulletin," says the familiar ad. in Philadelphia. And likewise, almost everybody on the Amateur bands has a v.f.o. these days, except rock-bound Novices, of course. However, their day will come, and this article should be of interest to them also.

Most home-made v.f.o's. and some commercial models (including those in transmitter units) suffer from "drift-itis," a disease whose severity is proportional to the patient's temperature. Much has been written by knowledgable authors on the subject of v.f.o. frequency stability, but unfortunately no one has yet been able to divorce the heat-producing vacuum tube from its connection to a tuned circuit which is supposed to maintain stability. This would be a neat trick if one could do it!

With the advent of semiconductors in plenty, however, there is promise of real progress in the field of stable frequency generation with very simple circuitry within reach of the Amateur pocketbook. The v.f.o. described here is my own answer to that requirement. Impetus was added to my motivation by the necessity of operation on Navy M.A.R.S. and Naval Reserve frequencies outside the Amateur bands with adequate stability (0.003% tolerance), which previous vacuum tube v.f.o's. did not do.

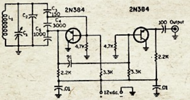


Fig. 1.—Circuit of the "Synthetic Rock" v.f.o. The tank circuit components, L1, C1, and C2 are ARC-5 oscillator components, the values of which are dependent upon the ARC-5 chosen and the frequency desired. All resistors are ½ watt, all capacitors greater than one in value are in pF., and less than one in value are in μF.

CONSTRUCTION

This transistorised v.f.o. is extremely simple to build, and is quite inexpensive. In a previous issue of "CQ,"[1] I described a v.f.o. built from a cut-down ARC-5 command set. For those who do not have the back issue, the ARC-5 chassis was cut just ahead of the oscillator section, the front panel was moved back, the amplifier tuning capacitor, with its dial, replaced the oscillator capacitor, and the ARC-5 oscillator components were used in a vacuum tube circuit.

The same mechanical concept is used in the transistorised v.f.o. described here, but the process of "cutting down" is carried to the extreme by stripping out all the wiring and components except the oscillator tuning capacitor below the chassis, and the coil and padding capacitor above the chassis.

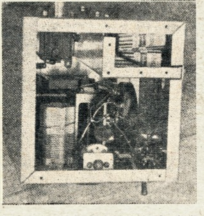
● Here is a v.f.o., using two transistors and ARC-5 components, that is so stable that it may be considered a "synthetic rock". Since it is made primarily from ARC-5 parts, it is very economical.

Two 2N384's are mounted on terminal strips beneath the chassis, and with the addition of a few capacitors and ½ watt resistors, plus a coaxial connector and two batteries, the unit is wired up as shown in Fig. 1. The two Z4 6-volt batteries in series provide the 12 volts power for the unit. Eight No. 1 flashlight cells can also be used in series, and will fit in the space at the rear of the chassis.

STABILITY

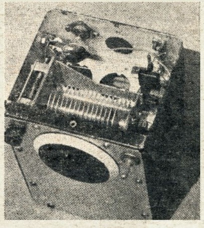
One of the secrets of the excellent frequency stability of this unit is the fact that the oscillator transistor is connected across a relatively low impedance (C4 and C5), and is quite loosely coupled to the tuned circuit through the voltage divider action of C3, C4, and C5. This effectively removes the transistor from the frequency determining tank circuit itself. In fact, C3 could be made even smaller if desired. Its lower limit would be that capacity which still permits the circuit to maintain oscillation.

This circuit is the result of much trial and error. Many published circuits involve connection of the transistor across high tank circuit impedances, resulting in a peculiar instability which manifests itself as a low frequency rumble or burble on the signal. It was actually an irregular frequency shift of only a few cycles (perhaps less than five cycles) about a very stable mean frequency, but the frequency could be seen as a fluctuation of the receiver S-meter. The long-term frequency stability was excellent, but the burble was there due to making the transistor look into too high a tank circuit impedance.



Bottom view of the transistorised v.f.o. built around an L.M. tuning capacitor and housed in a 6 x 6 x 6 inch cabinet. The battery compartment at the rear holds eight No. 1 flashlight cells. An ARC-5 coil form is used for L1 for improved stability.

The 2N384s work very well in the circuit shown here. The emitter-follower buffer provides excellent isolation from anything that follows that stage. The v.f.o. can of course be designed to work on any frequency you wish. In my case I use it on 4.9-6.1 Mc. to provide the injection frequency for the s.s.b. exciter.[2] It drives the 6AH6 which formerly functioned as the L.M. v.f.o. doubler in the exciter. It is connected to the transmitter through 10 feet of RG-8/U cable. The 2N384 is so stable in this oscillator circuit that it could actually be keyed on and off for c.w. by merely opening the 12 volt battery lead, with no chirp or frequency instability!



Bottom view of the transistorised v.f.o. built on a cut-down ARC-5 chassis. A false front panel is used to cover the extra holes. The r.f. output jack can be seen in the rear left corner.

This v.f.o. has been in use at W3JHR for four months as of this writing. The batteries were replaced once, at the end of three months, when their combined voltage dropped to 7 volts under load (a few milliamperes!). This included several periods of being left on all night in error. The only noticeable effect of the low voltage was a slight decrease in output. Use of a pilot light, while desirable from the standpoint of showing the "on" condition, would run the batteries down much more quickly, so it was omitted.

The v.f.o. is used when operating on the Navy frequency of 4015 kc. and it keeps me on frequency with better

(Continued on Page 20)

* Reprinted from "CQ," September 1963.

1 Lee, Paul, "Low Cost V.f.o.," "CQ," July 1955, page 33.

2 Lee, Paul, "Crystal Filter Type S.s.b. Exciter," "CQ," November 1961, page 32.

EARTHING

RALPH W. BIRRELL, VK3ZNE*

EARTHING or grounding is very important in electrical installations yet the reasons for earthing are often not clearly understood even by some electricians. A Ham Station is an electrical installation and must comply with the wiring rules for such installations. These rules are now uniform over Australia, even if given different titles in different States, as they are based on the Standards Association of Australia Wiring Rules A.S. No. CC1 Part 1, 1961.

Rule 501a states that all equipment except double insulated must be earthed (double insulation is used mainly on power hand tools such as drills; all live metal parts being covered with at least a double layer of plastic insulation). There must be a main earthing conductor from the earth connection at the main switchboard to the water pipe or other earth electrode, the minimum size of this wire is 7/.036. In house wiring, earth wires then run from the earth connection at the main switchboard to the earth pins of 3-point plugs with minimum size 3/.029. The connection of this wire must be done by a licensed electrician.

This appears straightforward, but there is one catch. Many three-pin plugs have been installed under older regulations without any earth connection between the three-pin plug and main switchboard. Using a three-core flex with earth wire may be useless if there is no earth wire from the plug base to the main switchboard. A check should always be made on any three-pin plug base to see if there is an earth wire connected.

Gas pipes and sprinkler pipes must not be used for earthing. A water pipe would appear to give a good earth but this can only be relied upon if the shack is on damp earth or clay and the pipes are below the water table. Many parts of Australia are rocky and dry and earthing of water pipes can be a real problem. If fibre pipes are used for the water supply no reliance can be placed on the water pipe as an earth.

I feel that the only safe way is to install a station earth bed completely independent of the water supply pipes and to earth all exposed metal parts in the station to this earth bed. Large scale earth beds are made by burying cast iron pipes in wet coke with the earth conductor being solidly bolted to the pipes. A simpler method is to drive one or more copper rods into the ground at least four feet. Galvanised ¾" water pipe will be equally as good if at least 4 feet long. The more rods or pipes in parallel, the lower the earth resistance, and the pipes should be spaced at least one foot apart and connected to each other with 7/.029 copper wire.

The earth wire should be terminated with a Ross Courtney and bolted to the pipe or connected to the pipe with an electrician's earthing clamp. The connection should be made and then painted to prevent corrosion and should be scraped and repainted at least every 12 months. The earth bed should be in the open and should be kept damp. All soils dry out in summer and this causes a rapid rise in earth resistance.

TEST AFTER INSTALLATION

A simple and reasonably accurate method of testing the earth bed is to use the fall of potential method.

Alternating current is circulated through the earth G and a fixed test earth G1 (see Fig. 1). A high resistance voltmeter is connected to G and to a movable test probe P. P is moved along a line from G to G1 and voltmeter readings taken simultaneously with ammeter readings.

$$R = E \div I$$

Values of R are plotted against distance and the flat part taken as the earth resistance.

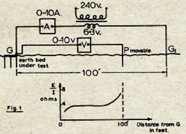


Fig 1

LIGHTNING PROTECTION OF ANTENNA TOWERS

Towers should have a pointed spike or finial projecting at least 3 feet above the top of the antenna, with an earthing conductor running from the finial to a separate earth. The wiring rules require the use of a separate earth at least six feet from any other earth connections. Lightning currents may be many thousands of amps. in magnitude, but they are pulses of very short duration, so the heating effect on the conductor is usually small. A 7/.029 copper earthing conductor should be ample.

REASONS FOR EARTHING

This discussion applies to the multiple earthed neutral (M.E.N.) system.

Where the user of the electrical equipment with exposed metal parts cannot earth himself, that is, he is in a room with dry wooden floors with no water pipes or other earthed metal within reach, there is no need to supply an earth on the equipment. However, this situaion seldom occurs in practice and every station should be treated as an earthed situation.

Rule 522b states that the resistance of the conductor from the earth electrode or water pipe shall not exceed 2 ohms. This is easily obtained with stranded copper earth wire, but care should be taken if cast iron forms part of the conductor circuit as cast iron may have quite a high resistance.

Rule 556 lays down that the resistance of any earth electrode shall not exceed 200 ohms.

I feel that for safe operation an overall resistance of not more than 4 ohms for the earth bed is absolutely necessary. In a normal house a 30 amp. or 45 amp. fuse is connected in the main switchboard feeder from the street pole and a 15 amp. fuse or smaller to the sub-circuit. The neutral return wire is bonded to earth at both the sub-station transformer neutral and the main switchboard with the earth providing an alternative path back to the transformer if the neutral wire becomes disconnected.

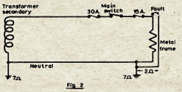


Fig 2

Consider the circuit as shown in Fig. 2 with the neutral wire connected normally. If a fault occurs between active and frame, the current will be 240 ÷ 2, that is 120 amps., and the 15 amp. fuse will blow. Now suppose for some reason the neutral wire no longer is in circuit and all current must return through the earth. If the earth resistance is 7 ohms at the house and at the transformer, then the current is 240 ÷ (7 + 7 + 2), that is 15 amps., and the fuse will just blow. Any higher resistance than this and the fuse will never blow. The metal casing of the rig will be at 240 volts to earth.

We have neglected the resistance of the active between transformer and appliance, the resistance of neutral between appliance and transformer, and the resistance of the earth itself, about 0.09 ohm per mile, and secondary reactance. If these are considered, the fault current will be smaller than 15 amps.

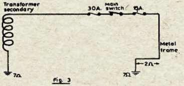


Fig 3

Considering the unknown resistances and reactances, it seems to me that a maximum resistance between electrode and earth of 4 ohms should be the aim to make the installation safe under conditions likely to be met in practice.

The lower the earth resistance the more likely the 15 amp. fuse is to blow and disconnect the supply to the rig and remove the possibility of the exposed metal being at 240 volts to earth. The danger of putting a heavier fuse

(Continued on Page 17)

* C/o. Technical College, Bendigo, Vic.

WARBURTON FRANKI

For Your Radio and T.V. Accessories

W.F. are now distributors of the Famous CANNON PLUGS

Types available from stock include:—

XL-3-11	3-Pin Female Line	9/6 + S.T. 12½%
XL-3-12	3-Pin Male Line	9/- + S.T. 12½%
XL-3-13	3-Pin Female Panel	9/6 + S.T. 12½%
XL-3-14	3-Pin Male Panel	7/3 + S.T. 12½%
XL-3-15	3-Pin Right Angle Female Line	24/- + S.T. 12½%
XL-3-42	3-Pin Floor Receptacle Male	9/- + S.T. 12½%
XL-4-11	4-Pin Female Line	13/- + S.T. 12½%
XL-4-12	4-Pin Male Line	12/- + S.T. 12½%
XL-4-13	4-Pin Female Panel	13/- + S.T. 12½%
XL-4-14	4-Pin Male Panel	10/4 + S.T. 12½%

Enquiries welcomed for other types.

METAL SPEAKER BOXES

Finished in Grey Hammertone Enamel.

Oval 5" x 3"	47/6	Round 6"	20/8
Oval 7" x 4"	57/6	Round 8"	23/4
Oval 9" x 6"	75/-	All Prices + S.T. 25%	

The round speaker boxes are open backed, but the oval ones are completely enclosed.

TRANSISTOR AUDIO AMPLIFIERS

PK 544. Five Transistors—push-pull output. Works from 9 volt battery. Low impedance input; output impedance 8 ohms. Boxed with circuit and wiring instructions.

100/- + S.T. 25%

BARGAINS!

● SILICON DIODES

400 p.i.v. at 1 amp.

6/3 each or 70/- doz. + S.T. 25%

● DYNAMIC MICROPHONES

High impedance with in-built stand.

24/- + S.T. 12½%

● GANGED POTS

With d.p.s.t. switch, 2 meg. linear.

7/9 + S.T. 25%

● CHASSIS PUNCHES

Hammer Type. Locally made and guaranteed. Set of three, ⅝", ¾", 1-3/16".

59/6 S.T.E.

● AMERICAN TAPE

Irish Brand, 5" 1,200' Reels, Mylar Base.

47/6 inc. tax and postage

MATRIX BOARD

New Miniature Series

Hole size: 0.045", hole spacing 0.1".

Stock Sizes of Boards:
3" x 3" 2/10 + S.T. 12½%
6" x 6" 9/6 + S.T. 12½%
9" x 9" 20/- + S.T. 12½%

Other sizes available up to max. of 34" x 24".

Hardware to suit:
No. 253 Wedge Pin **9d. doz.**
No. 285 Eyelet Tag **1/- doz.**
No. 314 Turret Pin **7d. doz.**

SOLDERING IRONS

Six-Second Push-Button Type

Uses screw-in copper tips and carbon elements. Supplied complete with transformer for mains use, or may be used from accumulator.

85/- S.T.E.
+ Pack and Post 2/6.

NEW—2-W. TRANSISTOR AUDIO AMPLIFIERS

Completely encapsulated in Epoxy Resin. Size: 3¾" x 2" x ⅞". Works from voltages of 4½ to 12. Output impedance 3.2 to 45 ohms. Leaflet supplied shows how to use as:—

- Stereo Amplifier.
- Stereo Converter.
- Intercomm.
- P.A. System, or as
- Signal Tracer.

£6 + S.T. 25%
+ Pack and Post 1/-.

2-STATION TRANSISTOR INTERCOMM. UNITS

Complete with connecting wire and battery.

80/- + S.T. 12½%
+ Pack and Post 2/-.

SIGNAL GENERATORS

LEADER—Combines Quality with Low Price

LSG10

Frequency Range: 120 Kc. to 260 Mc. (six bands) and Calibrated Harmonics 120 to 260 Mc.

R.F. Output: Over 100,000 Microvolts.

R.F. Control: Variable with two taps.

Modulation Frequency: 400 c.p.s.

A.F. Output: 2-3 Volts.

A.F. Input: Approximately 4 volts.

Valves used: One 12BH7 and one 6AR5.

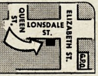
Size: 6½" x 10" x 4½". Weight: 6 lbs.

Price £12/16/- + S.T. 12½%

Pack & Post: Vic. 5/-, other States 7/6.

WARBURTON FRANKI

359 LONSDALE ST., MELBOURNE — MU 8351



- TRADE ALSO SUPPLIED
- OPEN SAT. MORNING

Please include postage or freight with all orders.

SOME NOTES ON THE USE OF R.F. CHOKES*

R. G. CHRISTIAN, A.M.I.E.E., A.M.Brit.I.R.E., G3GKS

THE radio frequency choke is an extremely useful component which makes its appearance in a wide variety of circuits. In fact in some cases the operation of the circuit is vitally dependent on the use of one or more r.f. chokes although the chokes may have little effect on the design of the circuit and as a result tend to be regarded as of little consequence. This viewpoint is in some instances an incorrect one, particularly where the choke is regarded as an anode load when in fact it is not acting as such.

The purpose of this article is to examine whether the choke is being effectively used. In doing so the writer hopes to explain the reason for a complaint, often heard, that the multiband exciter or driver unit being used fails to provide sufficient drive on 10 metres whilst operating quite satisfactorily on the lower bands. The requirements of harmonic amplifiers for frequency calibrators are also discussed.

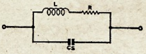


Fig. 1.—Approximate equivalent circuit of an r.f. choke.

THEORY OF R.F. CHOKES

The r.f. choke is wound to provide a certain inductance, usually of the order of several millihenries for medium frequency use. The winding resistance is generally rather large compared with that of a tuning coil, with the result that the Q-factor is on the small side, but unless the choke is to be used as the inductance element in a tuned circuit, this low Q is not a disadvantage. The choke inevitably has some self-capacitance which may be minimised by winding it in several sections of "pies" so that the stray capacitance is effectively made up of several smaller capacitances in series. The stray capacitance is really distributed throughout the winding but for simplicity may be regarded as consisting of a "lumped" capacitance. The r.f. choke, shown in a circuit diagram as a pure inductance, is in fact acting as a circuit consisting of inductance L and resistance R, in parallel with a capacitance C_s, as in Fig. 1. Some measurements made on a nominal 1.5 mH. choke of well known make showed that L was in fact 1.5 mH., C_s was about 1.4 pF. and the Q ($= \omega L/R$) varied from 16 at 180 kc. to 3.5 at 400 kc.

At very low frequencies the choke behaves very nearly as a pure inductance and produces a reactance of ωL which increases with frequency. The actual reactance is modified by the presence of the capacitance C_s and, to a much smaller extent, the resistance R. Neglecting the effect of the resistance, the effective inductance is modified from L to L^1 such that $L^1 = L/(1-\omega^2 LC_s)$. In other words the effective inductance increases with frequency due to the stray capacitance. As the frequency is increased, however, the inductive and capacitive reactances will become equal (neglecting R), so producing parallel resonance. The parallel resonant frequency is given by $f_o = 1/(2\pi\sqrt{LC_s})$. In the case of the example quoted above, since L = 1.5 mH. and C_s = 1.4 pF., the self-resonant frequency works out to 3.5 Mc. and this value was confirmed by actual measurement of f_o.

Above this self-resonant frequency the choke behaves as a capacitance of very small value but of course its reactance decreases with frequency. Due to the fact that the self-capacitance is really distributed, there is a possibility of self-resonance at several other frequencies. These may not cause ill-effects provided they are parallel resonances but it is possible for the capacitance of one part of the coil to produce series resonance with the inductance of another part. Since a series resonance provides a low-resistance path and as the duty of the choke is to provide a high impedance, it follows that such resonances are to be avoided if possible, particularly in the bands being used.

For the purposes of this article, it will be assumed that only one simple parallel resonance exists. If this is so, then at frequencies well above f_o the choke will behave effectively as a capacitance C_s with a reactance $1/\omega C_s$. Most of the foregoing theory assumes that the choke is in complete isolation, whereas in practice it must be considered as part of the circuit in which it is used.

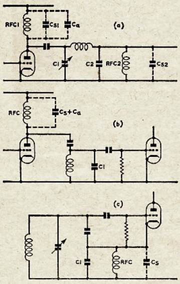


Fig. 2.—Effective use of r.f. chokes. (a) Power amplifier with pi-coupler; (b) Choke coupled tuned load; (c) Colpitts oscillator.

EFFECTIVE USE

Three examples of the effective use of an r.f. choke are shown in Fig. 2. In every case the choke is used to provide a d.c. path for the valve and in the case of Fig. 2(a) and (b) also provides a means of coupling the load to the valve. In any valve there will be stray capacitances associated with both grid and anode together with stray wiring capacitances. These capacitances may be considered, along with the self-capacitance of the choke, as part of the tuning capacitance C1 in Fig. 2(a) and (b) and may in general be ignored on the assumption that C1 is much larger than the total stray capacitance.

The choke behaves in these circuits as a low resistance path to d.c. and as a high inductive reactance at the frequency of operation. For example, our 1.5 mH. choke has an inductive reactance of about 270K ohms on 10 metres and since the load connected to the anode of the valve consists of a resonant circuit having an effective resistance much less than 270K ohms, the choke has practically no effect on the circuit. The same is true of the second choke RFC2 in Fig. 2(a), the stray capacitance effectively forming part of C2 in the pi-network. Again in Fig. 2(c), the choke provides a d.c. path for the valve whilst its stray capacitance is effectively part of C1.

INEFFECTIVE USE

A common use of the r.f. choke is in the circuit of Fig. 3 which could be an amplifier or the anode circuit of an electron coupled oscillator. The choke provides a d.c. path for the anode current of the valve but it does not constitute the a.c. anode load. This is because of the stray capacitances C_s, the stray capacitance of the choke (C_s), the output capacitance of V1 (C_g), the input capacitance of V2, and C_w the capacitance due to wiring and proximity of components, etc. If V1 and V2 are pentodes, the total stray capacitance ($C = C_s + C_a + C_g + C_w$) may have a value of between 20 and 40 pF. which may be considered as being effectively in parallel with the inductance L of the choke. The anode circuit will have a parallel resonance at $f_o = 1/(2\pi\sqrt{LC})$ so that if L = 1.5 mH. and C = 30 pF., then f_o = 0.75 Mc. which is well below any of the Amateur bands.

Below this frequency f_o the anode load is inductive having an effective reactance of $\omega L^1 = \omega L/(1-f^2/f_o^2)$ if we ignore the resistance of the choke. At frequencies higher than f_o the anode load is capacitive and has an effective reactance of approximately $1/\omega C$. The important conclusion we reach is that the anode load decreases as the frequency increases. Now the gain of V1, as a linear amplifier at least, is given approximately by $A = g_m/\omega C$ which means that the gain is inversely proportional to frequency. In other words the gain is halved each time the frequency is doubled. For a value of

* Reprinted from "R.S.G.B. Bulletin," October, 1963.

C = 30 pF. the anode load is roughly 1,400 ohms at 80 metres and falls to only 180 ohms at 10 metres.

Bearing in mind there is no resonance in the bands used, or so we assume, there can be no flywheel action as in a tuned class B or C amplifier, hence the output from V1 is going to decrease with frequency and could well be too small on the highest frequency bands. This effect could be the reason why very often a multiband driver stage using a choke in the anode circuit will not provide sufficient drive on 10 or even 15 metres, yet gives ample drive on the lower frequency bands. If this occurs, one possible solution might be to attempt to reduce the stray capacitances by changing component layout and by replacing V2 with a valve having a smaller input capacitance. It should be remembered that if V2 is made up of two valves in parallel, as is often the case with a p.a. stage, then the input capacitance is doubled. Substituting one larger single valve may be effective in reducing C_g. Should these methods fail to give sufficient drive probably the only solution is to replace L in the driver V1 by a suitable tuned circuit or wideband coupler. Replacing L by an r.f. choke of larger inductance will generally make the situation worse since a larger choke is likely to have a larger self-capacitance.

HARMONIC AMPLIFIERS

The circuit of Fig 3 is often seen in crystal calibrators where it may form the output circuit of the crystal calibrator or it may in fact represent a buffer or harmonic amplifier. The amplitude of the harmonics generated by an oscillator or amplifier tend to decrease with increasing order of harmonic, e.g. the amplitude of the twenty-fifth harmonic tends to be weak compared with that of, say, the fifth. Now if the harmonic output is fed into a circuit of the type represented by V1 in Fig. 3, then the harmonic amplitudes will be further reduced relative to each other because the gain of V1 is inversely proportional to frequency.

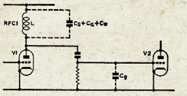


Fig. 3.—Ineffective use of r.f. choke as a.c. load.

It is convenient to consider a square wave applied to the grid of V1 because such a wave contains harmonics whose amplitudes decrease inversely as the order of the harmonic. In other words, the fifth harmonic has five times the amplitude of the twenty-fifth harmonic. Since the gain of V1 is inversely proportional to frequency, it follows that in V1 our fifth harmonic is amplified five times as much as the twenty-fifth which is already only one fifth as strong as the fifth. Thus at the anode of V1 the fifth harmonic is now 25 times as strong as the twenty-fifth. Obviously the characteristic of V1 is not the best one, because weak harmonics are being made weaker relative to the strong ones.

What is required of V1 is that the gain should increase linearly with frequency so that at the anode of V1 the fifth and twenty-fifth harmonics have equal amplitudes. Even if the input to V1 is not a square wave, it will still be a wave in which the harmonic-amplitudes decrease with order of harmonic and again the ideal gain characteristic of V1 is one that increases with frequency. One possible solution would be to reduce the value of L to a small value so that resonance with L and C occurs at a frequency higher than the highest harmonic required. For example if C = 30 pF. and the highest harmonic required is 30 Mc., then L could have a value $L = 1/\omega_o^2C = 9.4\ \mu H$. However, at low frequencies the reactance of L, and hence the anode load, is so small that the gain of the stage would be very much less than unity, e.g. at 1 Mc. the 9.4 μH. inductance has a reactance of only 59 ohms and if V1 had a mutual conductance of 10 mA/V the gain would be 0.59. This gain of course increases with frequency and at 20 Mc. for example would be about 20 times as large. If such a system is used the stray capacitance C should be kept as small as possible so that L may be made as large as possible.

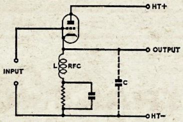


Fig. 4.—Cathode follower harmonic amplifier.

An alternative idea would be to use a cathode follower with a choke as the load as in Fig. 4, since the gain of a cathode follower is less affected by variations in load impedance and hence frequency than that of the common-cathode circuit of Fig. 3. The cathode load now consists of the choke in parallel with stray capacitances but these strays will be smaller than those in Fig. 3, thus the decrease in gain will be moderate. It should be borne in mind that the voltage gain of a cathode follower is always less than unity due to the entire output voltage being fed back in series with the input producing 100 per cent. negative feedback. However, the power gain is much greater than unity due to the very high input and low output impedance. Since the circuit in this application will generally be feeding low impedance loads such as the aerial input of a receiver for example, the fact that the voltage gain is less than unity will not be a serious disadvantage. The choke could of course be replaced by a small inductance as suggested previously for Fig. 3 in which case moderate compensation for the fall in harmonic amplitude would be achieved.

Inductive compensation as used in wideband amplifiers and the use of delay-lines as in distributed amplifiers are aimed at producing a level response, as opposed to a rising characteristic and are outside the scope of this article.

In concluding, the writer hopes that this article will induce some second thoughts about the much neglected r.f. choke and that consequently this essential component will merit a little more attention in circuit design. ●

☆

HINTS AND KINKS

BETTER HEAT RADIATING TUBE SHIELDS

K9APE suggests that HX-30 owners boil the tube shields of all the tubes, except the one for the 6360, in salt water. This blackens the shields and increases their ability to radiate heat, thus extending tube life. I tried the scheme and found that I now can touch the driver tube of my HX-30, which I could not do before the salt water treatment.

—Reprinted from "QST," Oct. 1963.

SHIELD CAN SOURCE

Fluorescent light starters have aluminium cases which make excellent miniature shield cans. The shields measure 13/16 inch in diameter and about 1¼ inch in length. Four tabs at the open end of the shield can be run through the chassis and bent for mounting.

—Reprinted from "QST," Oct. 1963.

"QRX! The V.f.o's. drifting again."

A.N.A.R.E. BASES

Most Amateurs are now familiar with the fact that the A.N.A.R.E. has several bases in the direction of the South Pole from Australia. Most would also be well aware that Amateur Radio call signs for such locations used the prefix VK1 for some years until the current VK0 replaced the former. But how many can remember the year in which each of the A.N.A.R.E. locations "opened shop"?

To refresh your memory, in case you have forgotten, here they are:

1947—Heard Island and Macquarie Island.
1954—Mawson Base.
1956—Davis Base.
1958—Wilkes Base.

Heard Island closed operations in 1955.

Davis Base is 400 miles east of Mawson Base, and Wilkes Base is 1200 miles east of Mawson Base.

—WIA-L3042/BERS195.

6-METRE A.M. TRANSCEIVER

RUSS HARDIDGE, VK3ZRH*

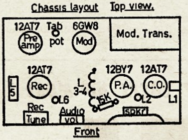
THE rig to be described here runs eight watts to the plate of a 12BY7 to give an r.f. output of 4 to 5 watts—suitable for most local working and also some DX if the band is open and a reasonable aerial (and QTH) is available. The sensitivity of the "rush box" receiver is ample for local work when operating portable or mobile.

It was originally intended to use the transceiver for operation on the 6 metre a.m. net frequency of 53.032 Mc. for portable and mobile use and also possibly for W.I.C.E.N., however results with the transmitter have been so heartening it is also used as the shack transmitter in conjunction with a home-brew superhet receiver. For use in the shack the regeneration control is simply turned off and a jack inserted in the earth lead of the T-R switch and connected to the normal relay system in the shack.

The original transceiver used trimmers to tune the final tank and adjust the antenna loading because fixed frequency work only was intended. However if shack use is intended, normal variable capacitors of about 50 pF. maximum capacity with the controls brought out to the front panel would be preferable. V.f.o. can be used, utilising the present overtone circuit as a doubler or tripler (**not** straight through) if the junction of the 47 pF. and 0.001 μF. capacitors is earthed.

* 21 Mitcham Road, Donvale, Vic.

The modulation transformer is a standard single-ended speaker transformer with primary 7K (to 12BY7), tapped at 5K (to 6GW8) primary (common to B+), to 3.5 ohm secondary. This gives a much better impedance match than the normal centre tapped transformer or with choke modulation. The current drawn on transmit is in excess of the manufacturer's figure of 50 mA., but the A. & R. transformer type 2624 used in the original has shown no signs of panic. With modulation, the current cancelling effects of the auto transformer configuration helps to prevent any breakdown.



A crystal mike was used purely because of personal preference, however a carbon mike could be used in the normal manner with the saving of one tube; alternatively, the unused half of the 12AT7 could be used as a tone generator. Do not bypass the cathode of the 12AT7 pre-amp. unless you particularly want r.f. feedback.

With the screen bypass used, the 12BY7 should not need neutralisation, but do not forget to check; inductive neutralisation from plate to grid would probably be the easiest method. While the final was quite stable, 12BY7s have been known to take off when used straight through on 50 Mc. A brass plate across the socket, between plate and grid lugs, should cure this if it should occur.

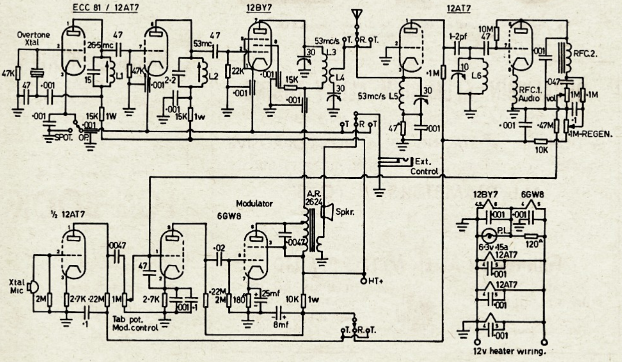
LAYOUT

All components except modulation transformer, screen dropping resistor, final tank, speaker, T-R switch, regeneration control and, of course, all tubes, are below the chassis.

The only precautions are to make sure that tuned circuits likely to cause feedback are at 90° to each other, and that hot audio leads are shielded. There was some acoustic feedback when switching from transmit to receive in the original which was cured by using a switch on the mike. Removal of the r.f. bypass in the plate lead of the audio preamp. would prevent this, but may accentuate r.f. feedback—this is a matter for experiment.

ALIGNMENT

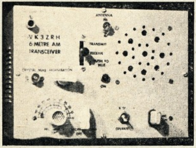
Transmitter: All coils were first grid dipped (dip the overtone coil approx. half a megacycle higher than crystal



frequency), then driver coils were adjusted for maximum grid drive to the 12BY7 (approx. 2 to 3 mA., depending on crystal; at least 1½ mA. required for good modulation).

The final tank and loading were adjusted for maximum power up the stick—more satisfactory than tuning for minimum dip and then loading with this particular bottle. Plate current should be around 27 mA., screen current 6 mA. Adjust screen dropping resistor if necessary to allow 180 to 200 volts on the screen with 250 to 300 volts on the plate (measure with v.t.v.m. or high resistance voltmeter).

Modulation level is adjusted with a c.r.o. or until plate current just kicks upwards on peaks. The unit is capable of excellent modulation when properly adjusted.



Receiver: Grid dip the r.f. amp. coil to 53 Mc., or adjust for maximum gain. Grid dip the detector coil to 54 Mc. with minimum capacitance (or use a signal generator), then adjust number of plates on capacitor if necessary to tune down to 50 Mc. Tuning is quite broad and only a 4 to 1 vernier (scrounged from a transistor portable) was used in the original and found quite satisfactory. Adjust coupling "gimmick" (two pieces of hook-up wire wound together, or trimmer if more capacitance needed) for maximum sensitivity together with smooth regeneration. Maximum sensitivity, and selectivity, is right on the threshold of regeneration.

Spotting switch is for use with the main shack receiver and v.f.o.

COIL DATA

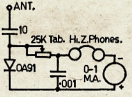
L1—10 turns 27g. close wound on Aegis 5/16" slug-tuned former.
L2—6 turns, as above.
L3—6 turns 10 or 12g. ½" i.d., half diam. spacing.
L4—2 turns hook-up wire over cold end of L3.
L5—6 turns 18g. ¼" diam., ½" long.
L6—6 turns as L1.
RFC1—Quarter wave length of 27g. on 5/16" former.
RFC2—Anything from 2.5 to 100 mH. choke.

AFTER-THOUGHTS

Power requirements are for 250 to 300 volts h.t. at around 100 mA. Either 6 volt or 12 volt wiring can be used. 12 volt was used in the original to allow for mobile work.

Chassis was aluminium, 8" x 5¼" x 2". The case was steel, louvred ends, 9" x 7" x 5½".

The receiver, like all super-regens., will radiate, but tests running it on the bench alongside the shack receiver show that radiation is not significant.



Tuning meter & Monitor.

TRANSISTORS

A transistorised version of the above is currently being constructed and will be described when final testing is complete. It is expected to run about the same power to push-pull AUY10s. It is intended to make this in two parts; a hand-held section running around 500 mW. for short haul W.I.C.E.N. work, and a linear final running about eight watts for installation in the car or for base station use.

Answers to any queries on the 6-Metre A.m. Transceiver or the transistorised version will be gladly given on the air or on receipt of a s.a.e.

ACKNOWLEDGMENTS

The following articles are acknowledged as providing various ideas incorporated in this design: "VK7 144 Mc. Communicator, "A.R."; "Compact Six Metre Transceiver," W3KET and W3TND, "Electronics World," April 1963.

Also thanks to all the six metre VK3 regulars for their helpful assistance on the air, with particular thanks to Jack VK3ZPG.

— • • • —

EARTHING

(Continued from Page 9)

wire in the 15 amp. fuse does not need emphasing.

For reasonably damp soils an earth resistance of about 1 ohm seems to be the minimum which can be obtained without a large amount of effort and expense.

240 volts are lethal. Most people can stand 50 volts without permanent effects, although I know an electrician who is severely affected by this voltage.

SUMMARY

To summarise:

(1) Every Ham Station should have a separate earth bed with a maximum resistance of about 4 ohms.
(2) Earth beds are most easily made using copper rods or galvanised ¾" water pipes driven at least 4 feet into the soil.
(3) The earth resistance should be measured when the bed is installed.
(4) Earth beds should be checked for corrosion every 12 months and the resistance measured again.
(5) Separate earth beds should be used for antenna towers.

BIBLIOGRAPHY

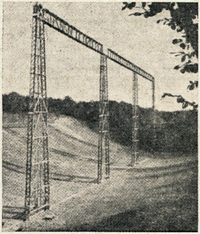
1. Australian Standard No. CC1, Part 1, 1961. S.A.A. Wiring Rules—Pt. 1—Wiring Methods, published by Standards Association of Australia.
2. Copper for Earthing. Twelfth impression, 1961, Copper Development Association Publication No. 30.
3. Standard Handbook for Electrical Engineers, A. E. Knowlton; McGraw Hill.
4. Symmetrical Components, Wagner and Evans; McGraw Hill.

WOOD FOR GIANT RADIO TELESCOPE

The fact that wood does not cause interference to radio signals is an important property which is being used to an increasing extent in this electronic age.

In the February issue of "Wood Preserving News," an American publication, there is an article concerning the extensive use of wood for construction of towers which support the antenna units of a giant new radio telescope at the University of Illinois.

Important considerations in the design of the antenna supports were the estimated required life of 15 years and the necessity to reduce to a minimum the electrical and radio interference characteristics. This also meant that the structure had to be as narrow as possible.



A guyed timber structure was chosen, consisting of four towers 165 ft. high, joined at the tops by three trusses from which the antennae are supported. The entire structure is only 4 ft. 8 in. wide.

The trusses are of plywood and glue laminated timber construction. All timber in the towers and trusses is preservative treated with pentachlorphenol, ensuring a virtually maintenance-free life.

Because non-metallic and non-conductor fasteners were required below the focal line, densified wood bolts, nuts, and washers were used. Densified wood is made from thin wood veneers impregnated with synthetic resin and densified by heat and pressure.

Only 17 days were required to erect the structure.

(Photograph by courtesy of "Wood Preserving News," Chicago, U.S.A., and extracted from C.S.I.R.O. "Forest Products Newsletter," Dec., 1963.)

CHANGE OF ADDRESS

W.I.A. members are requested to promptly notify any change of address to their Divisional Secretary, not direct to "Amateur Radio."

Wireless Institute of Australia

Victorian Division

A.O.C.P. CLASS

commences

MONDAY, 10th FEB., 1964

Theory is held on Monday evenings, and Morse and Regulations on Thursday evenings from 8 to 10 p.m.

Persons desirous of being enrolled should communicate with—

Secretary W.I.A., Victorian Division, P.O. Box 36, East Melbourne (Phone: 41-3535, 10 a.m. to 3 p.m.), or the Class Manager on either of the above evenings.

WIRELESS INSTITUTE OF AUS.

Federal Constitution Alteration

Federal Executive, on behalf of the Federal Council of the Wireless Institute of Australia, hereby gives notice that it is intended to alter the **Federal Constitution of the Wireless Institute of Australia 1947** as follows:—

(a) Delete Clause 21 and substitute—

"21. The Headquarters Division shall call for nominations annually from its members for appointment to the Federal Executive, such nominations to be received not less than 60 days prior to the conclusion of the fiscal year. The nominations which shall include the names of any retiring members of Federal Executive willing to re-nominate shall be submitted by the Headquarters Division to Federal Council for the appointment by preferential vote of seven members, two at least of whom shall be retiring members."

(b) Insert new Clause 21a—

"21a. The new Federal Executive shall take office at the conclusion of the Federal Convention which they shall attend, or where a Federal Convention is not held, within one month of the conclusion of the fiscal year. The Federal Executive shall determine its own offices in such manner as considered necessary."

(c) Delete Clause 24 and substitute—

"24. The appointment of Federal Executive which shall be finalised by the Headquarters Division not less than 14 days prior to the conclusion of the fiscal year shall be notified in writing to Federal Council prior to the conclusion of the fiscal year. The Federal Executive shall notify Federal Council in writing of the offices and appointees thereto within 28 days of the commencement of the new fiscal year or the Federal Convention whichever is the sooner."

Any member of the Institute not in agreement with the proposed alterations should notify his disapproval and the reasons to the Federal Secretary within 14 days of the publication of this proposal.

TECHNICAL ARTICLES

Readers are requested to submit articles for publication in "A.R.," in particular constructional articles, photographs of stations and gear, together with articles suitable for beginners, are required.

SIMPLIFIED CASCODE CONVERTER FOR TWO METRES*

FROM NOTES BY G3NBQ

THE details on which this article is based appeared in the Coventry Amateur Radio Society's "Newsletter" for April last, in which G3NBQ described a two-metre converter intended as a prototype for copying by C.A.R.S. members who might have had no previous experience of v.h.f. construction and circuitry. Several such converters have been built from his design, which is essentially simple and easy to get going—nevertheless, it is capable of giving very good results with the minimum of setting-up difficulty.

Fig. 1 is the block diagram, showing a cascode r.f. stage (E88CC) into a mixer (6AK5) with a twin-triode (12AT7) oscillator-multiplier — just about as basic a layout as you could get for an efficient crystal-controlled job on two metres.

At Fig. 2 is given the circuit in detail. The oscillator-multiplier chain is designed to knock out at 118 Mc., near enough, from a 6.5555 Mc. crystal, giving the i.f. tuning range of about 26-28 Mc. to cover the (two-metre) band, 144-146 Mc. The crystal frequency is times/3 in the first half of the 12AT7 and then times/6 in the anode of the second half. Provided beats are not thrown into either the i.f. tuning range of the receiver or the 144-146 Mc. signal frequency coverage of the converter, any tunable i.f. can be used by changing the crystal frequency and the order of multiplication in the oscillator chain—but in fact the arithmetic will show that there are relatively few fundamental crystal frequencies that can be used without this sort of interference occurring. The figures given here are to avoid "birdies" in the tuning range.

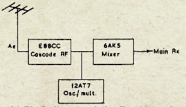


Fig. 1.—Block diagram of the Two-Metre Converter, which is easy to build and get going.

CONSTRUCTIONAL POINTS

The general appearance of the finished job, as built up by G3NBQ, is shown by the photographs. To simplify the constructional work, he hit upon the ingenious idea of using 18g. tin-plate, with tin screens, as the mounting, this assembly then being dropped into a standard aluminium box chassis. The advantage of using clean tin-plate, rather than aluminium, is the very important one that soldered joints can be made direct to the chassis. Moreover, since at the constructional stage the "chassis" consists of no more than a piece of flat tin, 5⅞" x 3⅞", to which the screens (two inches deep) can be soldered, the work is much more assessible than when building inside a small box chassis.

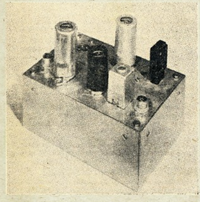
One screen is fitted along the centre-line of the mounting plate, and the other is placed at right angles to form a 1½" compartment at the input (V1) end—see under-chassis photograph—to screen the two halves of the cascode stage. This under-chassis view also shows how the wiring is simplified, and from it and a study of Fig. 2, starting from the V1 end, most parts can be identified.

After construction, it will be found that the mounting plate with its screens will fit neatly into an aluminium box 6" x 4" x 2½" deep, and can be bolted in by self-tapping screws.

ALIGNMENT

After doing a thorough wiring check, apply power. On connecting the converter into the main receiver, sharsh should be heard; if this is not so, then look over the mixer wiring. When

(Continued on Page 20)



General view of the Two-Metre Converter designed by G3NBQ. It was produced specifically as a prototype to be easily repeatable by any experienced home constructor wishing to make a start on v.h.f. with a good c.c. converter. In this shot, the input end is at upper left and the i.f. socket at lower right. As a simplified, though sound, basic design to the circuit given in Fig. 2, it can be relied upon to give satisfactory results for anyone without previous two-metre experience.

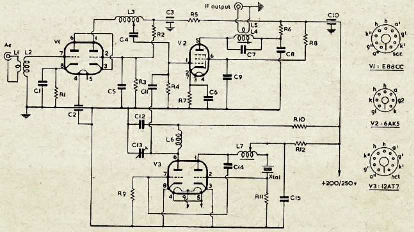


Fig. 2.—Circuit of the Two-Metre Cascode Converter. V1 is in cascode and the twin-triode at V3 multiplies a third-harmonic ("overtone") crystal frequency by six, to give an injection frequency of approximately 118 Mc. for a tunable i.f. range of 26-28 Mc. Other oscillator-i.f. combinations can be worked out to suit individual requirements, provided oscillator beats are not thrown into the receiving chain. The photographs show the simplified form of construction devised by G3NBQ, and the article explains the equally simple alignment procedure.

C1, C5, C12—0.001 μF. disc ceramic.
C2, C3, C10—0.001 μF. feed-through.
C4—47 pF. tubular ceramic.
C6, C8, C9, C15—0.01 μF. disc ceramic.
C7—5.6 pF. tubular ceramic (see coil data).
C11—2.2 pF.
C13—2-8 pF. beehive trimmer.
C14—100 pF. mica.
R1—68 ohms.
R2—220,000 ohms.
R3—330,000 ohms.
R4—100,000 ohms.
R5—10,000 ohms.
R6, R9—47,000 ohms.
R7—220 ohms.
R8—1 megohm.
R10, R12—4,700 ohms.
R11—22,000 ohms.
Xtal—6.5555 Mc. x 3.
V1—E88CC (ECC88).
V2—6AK5.
V3—12AT7 (B309).
Note: All resistors rated ½ watt.

COIL DATA

L1—One turn round L2, of 20g. tinned copper, to ½ in. diameter.

L2—Four turns ⅜ in. diameter, 20g. enamel, spaced over ½ in. winding length.

L3—Four and three-quarter turns ⅜ in. diameter, 20g. enamel, spaced over ½ in. winding length, with C4 tapped on one turn from C3 end.

L4—25 turns 24g. enamel, close wound on ¼ in. diameter I.F.T.-type slugged former, fitted in can. Tuned to 27 Mc. by slug and C7. (These details for 26-28 Mc. I.F.).

L5—Five turns of flexible lead over earthy end of L4.

L6—Two and three-quarter turns ⅜ in. diameter, 20g. enamel, spaced over 3/16 in.

L7—For 6.5555 Mc. xtal: 25 turns 24g. enamel on ⅜ in. diameter slugged former, with tap at 3½ turns.

* Reprinted from "The Short Wave Magazine," September 1963.

Converter for Two Metres

(Continued from Page 19)

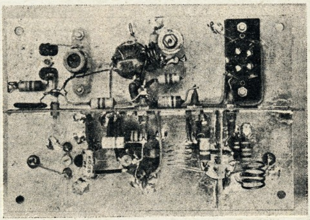
noise is obtained, check the c.o. grid current by disconnecting R11 at the chassis end and putting in a low-range milliammeter; this should show a pronounced peak reading on one setting of the slug in L7. If this does not happen, put a 10 pF. fixed capacity between ground and pin 1 of V3. If the grid current still will not peak, re-wind L7 with a few taps, and determine which tap gives greatest current. You are aiming to get a grid current reading of 0.5-0.7 mA. and when this is obtained, the meter can be taken out and R11 re-connected to the chassis.

If C13 is now adjusted, a noise-peak should be heard; no difficulty will be encountered here, as C13 shifts the resonant frequency of the tuned circuit through quite a wide range. Careful adjustment of L3, by spreading out or squeezing in its turns, should peak up the sharsh even more.

On connecting the aerial, something should now be heard from outside, even if it is only ignition noise (which can be very useful for preliminary adjustment of any converter!). There may even be a few signals on the band on which the signal circuits can be peaked by manipulation of L2 and L3, while fiddling with the configuration of L1 with respect to L2 may give you a further gain in signal. For the 26-28 Mc. tuning range on the main receiver, the i.f. winding L4 should be peaked at 27 Mc.

If having reached this happy condition, with something coming in on two metres, the converter appears to go quite dead after switching on again, it will be because the crystal has not picked up. This is a very annoying and not uncommon fault, and can only be prevented by careful adjustment of the c.o. in the first place. It may even be necessary to move the L7 tap a little, to increase the feed-back. In any case, the crystal should be checked out as a healthy oscillator before it is plugged in. The probability is that a strong c.o. beat will be found somewhere on the tuning range of the main receiver (right outside the two-metre band, that is) and this can always be used as a reference point for the activity of the crystal.

It is understood that those converters built to the recipe by G3NBQ, as discussed, here, are giving entirely satisfactory results, and went off first time without difficulty. The design can be confidently recommended to anyone thinking of making a start on the two-metre band. ●



Under-chass view of the Converter. The main dimension is 5⅞ in. and the "chassis" is actually a mounting plate, with screens, made of 18g. clean tinplate which simplifies the wiring because earth connections can be soldered. Two screens as shown are fitted (by soldering), the smaller one at right angles being 2 in. deep with a slot cut for the valveholder, and placed to give a 1½ in. space for the V1 input assembly. The finished converter on its mounting plate then drops into a standard 6 x 4 x 2½ in. box chassis, and is secured by self-tappers at the four corners. In this view the aerial input end is at lower right, and the i.f. output coax socket at left.

PHONE OPERATION BY L.A.O.C.P. LICENSEES

Pursuant to representation to the Postmaster-General's Department by the Wireless Institute of Australia, the following modes of telephony may now be used by licensees in the Amateur Service holding Limited Amateur Operator's Certificates of Proficiency authorising transmission in the bands above 52 Mc.:—

All authorised bands:
A3, A3a, A3b, F3.
All bands above 144 Mc.:
A0, P0.
Ultra high and super high frequency bands:
P3d, P3e, P3f.

Licensees will not be independently advised by the Postmaster-General's Department. Amateurs are therefore advised to pass this information by word of mouth and whilst in contact on the air.

FEDERAL EXECUTIVE, W.I.A.

— . . . —

Transistorised V.F.O.

(Continued from Page 7)

than the required stability of 0.003%, as evidenced by my stable zero beat with station NPG on that frequency. It is a constant source of joy when operating in the Amateur bands also. There is absolutely no drift from this source any more!

S.s.b. operators plagued by "driftitis" and a.m. operators whose frequency shifts with modulation would do well to build and use this little gadget. You c.w. men can actually key it for break-in! It is truly a "Synthetic Rock"! ●

Introduction to Ceramic Dielectrics

(Continued from Page 5)

PIEZOELECTRIC EFFECT

Crystals of quartz, tourmaline or seignette salt, suitably prepared, can show an electrostatic voltage charge on the electrodes if subjected to mechanical stress. This effect, which can also be reversed, is called "piezoelectricity".

It was quite a surprise when, in 1947, it was discovered that mixed crystal ceramics of certain HK types can also be made piezoelectric, after they have been polarised at elevated temperatures. Depending on the mode of operation, these versions of ceramic capacitors can be used as frequency determining element in crystal oscillators, as ultrasonic receiver or transmitter element, as gramophone pick-up element, as high-tension spark element to operate a motor car ignition system, or to measure the pressure time diagram of a gun or motor, to mention only a few applications. Another application, which may soon find wide use, is the transfilter, where discs suitably equipped with electrodes can successfully replace i.f. filters in radio receivers.

OTHER EFFECTS

We have mentioned already that nearly all properties vary if the measuring temperature, or voltage, or frequency, or the shape of the ceramic capacitor changes. Besides the chemical composition, comprising the main ingredients plus some desirable trace elements and many undesirable impurities, the many ceramic production operations, with their controlled and uncontrolled variables, affect the electrical properties of ceramic dielectrics as well.

Putting the electrodes on is not as simple or harmless as it appears either. Silver alone does not bond to the titanates; therefore, the metal paints contain ceramic flux (lead boro-silicate) plus other oxides (Bi_2O_3, TgO) to improve solderability. These ceramic materials react with the dielectric during the firing of the electrodes, more with the upper side than with the lower side of discs. The more flux the silver electrodes contain, the longer and higher the silver is fired; as a result, the K factor will be lower and all other properties affected.

HK bodies containing over 90% BaTiO_3 absorb far more flux than TiO_2 LK bodies. A disc, K : 10,000 0.010" thick, may lose 30% of the capacity if the wrong silver paint is used. In the case of the oxide skin type capacitors, even the organic solvents and binders affect the capacity. They do not seem to burn out completely.

Several additional effects come in, while the capacitors are being soldered and the solder fills the space between the silver grains. To all these properties and effects, we have to add some 80 variables, which are associated with the usual ceramic processes, according to a list published by the British Ceramic Research Association.

[Part Two, to appear in a later issue, discusses the other half of the job—"How to make Ceramic Dielectrics".]

SWAN

INTRODUCING THE NEW SWAN-TCU

TRANSMITTER CONTROL UNIT

COMPANION FOR YOUR SW-240

EXTERNAL VFO—provides for Separate Transmit-Receive Frequency Control

- Complete coverage of 20, 40, 75, and 80 metres.
- 100 Kc. Calibrator.
- 15 Mc. reception of WWV.
- VOX, Voice Controlled Operation, including Anti-trip.
- Built-in Speaker.
- Phone Jack.
- Plugs into **all** SW-240 Transceivers. (Complete with connectors and installation kit.)
- Operates directly from Transceiver supply. No additional power supply is required. Those who now own an SW-240 and A.C. supply need to buy only the Swan-TCU.
- The New SW-117B A.C. supply may be installed inside the TCU cabinet if desired, thus making a complete home station in two matching units.
- SW-240 Transceiver may still be used in mobile operation by simply disconnecting the TCU, and inserting a jumper plug.

THE FABULOUS SW-240 TRANSCEIVER

- 240 watts p.e.p. input.
- High frequency crystal lattice filter.
- Precision tuning mechanism.
- Exceptional frequency stability.
- Receiver sensitivity better than one microvolt.
- Automatic gain control.
- Break-in c.w. operation.
- Frequency coverage: 14,000-14,350 Kc., 7,000-7300 Kc., 3,500-3,850 Kc. (Kit for full 80 mx coverage available.)

SWAN ACCESSORIES

MOBILE MOUNTING KIT.—Locking type, including speaker switch, with front-mounted mike jack.

SIDEBAND SELECTOR KIT.—Provides both opposite sideband and a.m. receive position.

SW-117AC POWER SUPPLY with Matching Cabinet.—With 5" x 7" Speaker and Phone Jack.

SW-12DC POWER SUPPLY for Mobile Operation.—Has pre-wired Cables and Installation Hardware.

NOW A NEW SWAN A.C. POWER SUPPLY, SW-117B. Designed to fit inside the Swan TCU Cabinet or may be used separately to power the SW-240. Includes top and bottom covers and rubber feet.

AUSTRALIAN DISTRIBUTORS—

W.F.S. ELECTRONIC SUPPLY CO.

225-227 VICTORIA RD., RYDALMERE, N.S.W. Phones: 638-1715, 638-1355

Interstate Agents—

N.S.W.: ATLANTIC RADIO
36 Oxford Street, Woollahra — — Phone 31-7811

VIC.: ELECTRONIC SERVICES P/L.
10b Douglas Street, Noble Park — Phone 746-8446

S.A.: TELEVISION & RADIOTRONCIS
12a Gays Arcade, Adelaide — — Phone 23-2474

QLD.: GENERAL IMPORT DISTRIBUTORS
135 Lutzow St., Wellers Hill, Brisbane. Phone 48-5098

W.A.: NEIL JAMES & CO.
Barrack Street, Perth — — — Phone 24-8961